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Research Project No. 9, Estimating the Green Weight of Individual Slash Pine Trees Planted in East Texas

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ESTIMATING THE GREEN WEIGHT OF INDIVIDUAL SLASH PINE TREES PLANTED IN EAST TEXAS

by

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IN THE

EAST TEXAS PINE PLANTATION RESEARCH PROJECT

A STUDY OF

LOBLOLLY AND SLASH PINE PLANTATIONS

IN

EAST TEXAS

CENTER FOR APPLIED STUDIES

SCHOOL OF FORESTRY

STEPHEN F. AUSTIN STATE UNIVERSITY

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This is the ninth in a continuing series of reports describing results from the East Texas Pine Plantation Research Project.

Subject and content of each ETPPRP report is regional in scope and of particular interest to loblolly and slash pine plantation owners in East Texas.

Any suggestions, ideas or comments will always be welcomed.

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This report is based on a thesis being developed by Mr. Charlie J. Laman in his pursuit of a MSF degree. Expected graduation date is May '87.

J. David Lenhart
Project Director
October 16, 1986

ESTIMATING THE GREEN WEIGHT OF INDIVIDUAL SLASH PINE TREES PLANTED IN EAST TEXAS

by

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ABSTRACT. Equations are presented to estimate the green weight in pounds of the wood, bark and needles in the stem and branches of individual slash pine trees planted on site-prepared land in East Texas.

INTRODUCTION

The estimation of the content of individual trees is a principal component in the measurement process to determine per acre yields. In particular, the content of individual trees is a value needed in the last stages of the diameter distribution yield prediction method. Also, tree content information is useful in timber cruising.

In this report, equations are presented to estimate the green weight in pounds of individual planted slash pines on site-prepared land in East Texas as:

1. Complete Tree Green Weight Wood, Bark and Needles: CTGWWBN.
2. Complete Tree Green Weight Wood and Bark: CTGWWB.
3. Complete Tree Green Weight only: CTGWW.
4. Total Stem Green Weight Wood and Bark: TSGWWB.
5. Partial Stem Green Weight Wood and Bark: PSGWWB.
6. Total Stem Green Weight Wood only: TSGWW.
7. Partial Stem Green Weight Wood only: PSGWW.

By appropriate subtraction, the green weight of needles and bark in the branches can be determined. Green weight of bark on stem can also be calculated by subtraction. In addition, differences between total stem and partial stem values can be obtained for various multiple-product computations.

TREE MEASUREMENTS

A total of 52 slash pine sample trees located in the buffer zones of 26 of our 81 ETPPRP permanent plots in slash pine plantations were felled during January - March, 1986. Two trees were sampled per plantation. The distribution of the 52 sample trees by county and by dbh and height classes is shown in Figure 1.

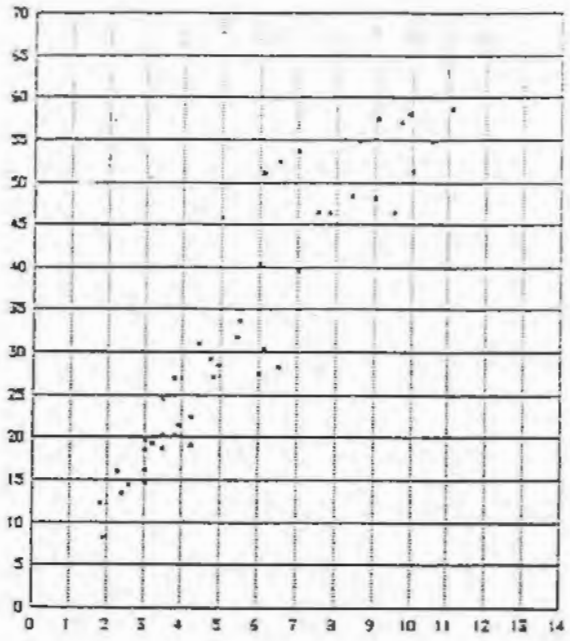
Prior to felling a tree, the dbh and crown class were determined. After felling, the branches were removed and weighed. A typical branch was weighed with and without needles. Eight branch segments (12" long) were cut and weighed with and without bark.

At 3-foot cut points along the stem, dob was recorded. Then the stem was bucked into 3-foot long bolts. Each bolt was weighed. At the bottom of each bolt, a 1- to 2-inch disk was cut. Each disk was weighed with and without bark. In addition, dib for each disk was noted. The top stem segment was also weighed and considered part of the stem.

The necessary field data was now available to compute observed tree green weight of wood with and without needles or bark as:

1. Partial stem to the top of each successive bolt.
2. Total stem.
3. Branches.

Green weight of bark and needles in branches was calculated using appropriate ratios of branch sub-samples. Green weight of bark on stem was determined using ratios from the bolt disks.



NUMBER OF SLASH PINE SAMPLE TREES BY DBH AND HEIGHT. n = 52 trees.

SLASH

n = 52 trees

Figure 1. Number of sample trees by county in Texas.

COMPLETE TREE GREEN WEIGHT ESTIMATION

Plottings of CTGWWBN, CTGWWB and CTGWW over dbh (D) and total tree height (H) indicated a model originally suggested by Schumacher and Hall (1933) as

$$\text{Tree content} = b_0 D^{b1} H^{b2} \quad (1)$$

represented the relationships seen in the plottings.

Non-linear regression analysis of the data set produced the following prediction equations as

$$CTGWWBN = 0.324671 D^{2.108976} H^{0.813285}, \quad (2)$$

$$CTGWWB = 0.156206 D^{2.033507} H^{1.011965} \quad (3)$$

and

$$CTGWW = 0.113526 D^{2.094336} H^{1.023721}, \quad (4)$$

with R^2 = 99% for each of these equations*.

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* All R^2 values in this report were calculated using non-linear regression results as:

$$R^2 = ((n-1)(\text{std dev dep var})^2 - \text{Residual SS})/((n-1)(\text{std dev dep var})^2)(100)$$

PARTIAL AND TOTAL STEM GREEN WEIGHT ESTIMATION

In a dissertation by McTague (1985), a new tree content estimation model was presented, that has several desirable properties:

1. Treats total stem content as a special case of partial stem content.
2. Predicts partial stem content between stump and any upper stem diameter limit.
3. Convertible to a well-behaved taper function.
4. Also, suitable for estimating green or dry weight of the total or partial stem.

Subsequently, Pienaar and others (1985) developed a variation of the original McTague model as

$$\text{Content wood only in the stem} = b_0 D^{b1} H^{b2} - b_3 (d^{b4}/D^{b4} - 2)(h - 4.5), \quad (5)$$

Where d = upper stem diameter o. b.

Equation (5) was used in non-linear regression analysis with a data set comprised of 540 cases of green weight wood and bark . The resulting equation is

$$PSGWWB = 0.079853D^{1.816699}H^{1.255593} - 0.139970d^{3.430826}D^{-1.430826}(H - 4.5) \quad (6)$$

with $R^2 = 98\%$.

If the value for the variable d (upper stem diameter o.b.) in Eq. 6 is set to zero (or the top of the stem), Eq. 6 collapses to

$$TSGWWB = 0.079853D^{1.816699}H^{1.255593}. \quad (7)$$

Equation (5) was also used in non-linear regression analysis with a data set comprised of 540 cases of green weight wood only . The resulting equation is

$$PSGWW = 0.065306D^{1.85780}H^{1.253557} - 0.124615d^{3.453380}D^{-1.453380}(H - 4.5) \quad (8)$$

with $R^2 = 98\%$

and

$$TSGWW = 0.065306D^{1.85780}H^{1.253557}. \quad (9)$$

Tables 1 and 2 show predicted green weight values for various combinations of D, H and d based on Eqs. 6 and 8, respectively.

TABLE 1. ESTIMATED GREEN WEIGHT OF WOOD AND BARK IN THE STEM TO SPECIFIED UPPER DIAMETER LIMITS FOR INDIVIDUAL SLASH PINE TREES ON NON-OLD-FIELD PLANTATIONS IN EAST TEXAS.

DBH (IN)	UPPER STEM DIAMETER LIMIT (IN)	TOTAL TREE HEIGHT (FEET)						
		20	30	40	50	60	70	80
2	0	12						
4	0	43	71					
	2	39	66					
6	0		148	213	281			
	2		145	208	276			
	4		116	168	224			
8	0			358	474	596		
	2			356	471	592		
	4			329	437	551		
	6			241	323	412		
10	0				712	895	1086	
	2				709	891	1082	
	4				584	861	1046	
	6				602	761	928	
12	0					1240	1512	1788
	2					1243	1509	1785
	4					1220	1482	1753
	6					1143	1390	1648
	8					969	1185	1411
14	0					1649	2001	2366
	2					1647	1995	2363
	4					1628	1976	2338
	6					1566	1903	2253
	8					1427	1739	2064

TABLE 2. ESTIMATED GREEN WEIGHT OF WOOD ONLY IN THE STEM TO SPECIFIED UPPER DIAMETER LIMITS FOR INDIVIDUAL SLASH PINE TREES ON NON-OLD-FIELD PLANTATIONS IN EAST TEXAS.

DBH (IN)	UPPER STEM DIAMETER LIMIT (IN)	TOTAL TREE HEIGHT (FEET)						
		20	30	40	50	60	70	80
2	0	10						
4	0	37	61					
	2	34	56					
6	0		129	186	246			
	2		127	182	241			
	4		101	146	195			
8	0			317	419	527		
	2			315	416	523		
	4			291	386	486		
	6			212	285	363		
10	0				635	798	968	
	2				632	795	964	
	4				611	768	933	
	6				537	679	828	
12	0					1119	1358	1605
	2					1117	1355	1602
	4					1097	1331	1575
	6					1028	1250	1481
	8					874	1068	1271
14	0					1490	1808	2137
	2					1489	1806	2135
	4					1472	1787	2113
	6					1418	1722	2038
	8					1294	1576	1870

LITERATURE CITED

McTague, J. P. 1985. Growth and yield of slash and loblolly pine in the state of Santa Catarina, Brazil. Univ. of Ga., Ph.D. Diss. 219 p.

Pienaar, L. V., B. D. Shiver and J. W. Rheney. 1985. Revised stem volume and weight equations for site-prepared slash pine plantations. Univ. of Ga., Sch. of For. Resources, Plantation Manage. Res. Coop. Tech. Rep. No. 1985-5. 22 p.

Schumacher, F. X. and F. S. Hall. 1933. Logarithmic expression of timber-tree volume. J. Agr. Res. 47:719-734.